My NASA Data

6-8: Introduction: Building Claims from Evidence   **Lesson Plan**

<u>Purpose</u>**:** Students will practice constructing claims using evidence and reasoning.

Grade Level: 6-8 **Time:** 1-45 minute class periods	**Lesson Objectives:** Students will practice the process of making claims, collecting evidence to support claims, and applying scientific reasoning to connect evidence to claims.	**Sphere(s):** n/a

Phenomena NASA Connection:

This lesson does not directly align with phenomena-based learning by addressing disciplinary core ideas but rather the scientific practice of engaging in argument from evidence which NASA scientists must perform daily. Essential to the nature of science, scientific knowledge is reliant upon a process of reasoning from evidence. This requires scientists to justify their scientific claim about the natural world, which in turn, other scientists attempt to refute by identifying weaknesses and limitations within the research. NASA is no stranger to having to justify claims associated with contentious topics like global climate, severe weather, or sea level rise. NASA scientists must argue or defend their claims through data interpretation, experimental designs, and data analysis. This is commonly found in the form of defending claims using evidence and reasoning, defending climate models using evidence, or reviewing and critiquing the claims of other scientists by looking for sufficient and appropriate evidence of claims.

Essential Questions:

1. Why do scientists gather, classify, sequence, and interpret information?
2. Why are making inferences/generalizations and justifying claims important in understanding our world?
3. How can you use evidence to justify claims?

NGSS Performance Expectation(s):

- Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. (MS-LS1-1)
- Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. (MS-LS1-3)
- Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-PS2-4)
- Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon. (MS-PS3-5)

Science & Engineering Practices: **<u>Engaging in Argument from Evidence</u>** Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. **<u>Asking Questions and Defining Problems</u>** Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. -- **Connections to Nature of Science** **<u>Scientific Knowledge is Based on Empirical</u>**	**Disciplinary Core Ideas**: n/a	**Crosscutting Concepts**: **<u>Cause and Effect</u>** ▪ Cause and effect relationships may be used to predict phenomena in natural or designed systems. -- **Connections to Nature of Science** **Science Addresses Questions About the Natural and Material World** Science findings are limited to questions that can be answered with empirical evidence.

Evidence Science knowledge is based upon logical and conceptual connections between evidence and explanations.		

NCTM Math Standards: n/a

Cross-Curricular Connections:
Common Core State Standards ELA Standards:
- CCSS.ELA-LITERACY.RI.6.7
  Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.
- CCSS.ELA-LITERACY.RI.6.8
  Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not.
- CCSS.ELA-LITERACY.RI.7.8
  Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims.
- CCSS.ELA-LITERACY.RI.8.8
  Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient; recognize when irrelevant evidence is introduced.

Career Connections:
- o General Scientist - A scientist is a person that works in a specific field to acquire or uncover knowledge related to the natural world.
- o Engineer - An engineer is a person that applies scientific knowledge, mathematics and imagination to develop real life solutions for technical problems.
- o Forensic Science Technicians - Assist in investigating crimes by collecting and analyzing evidence.
- o Reporters and Correspondents - Report and write stories for news outlets.

Multimedia Resources:
- PowerPoint or Google Slide showing the Fisherman Pictures on Separate Slides, as well as the movie file below
  - o [Continuous Movie File](#)

Materials/Resources Needed:
Per Student:
- Post-it Notes
- Marker
- Fisherman Observation Sheet
- Student Data Sheet 1
- C-E-R Rubric

Key Vocabulary:
claim
dependent Variable
evidence
independent Variable
qualitative Observation
quantitative Observation
reasoning

Background Information:

Teacher Background Content:
By the 8th grade, students are expected to construct and present oral and written arguments supported by empirical evidence and reasoning to support or refute an explanation for a phenomenon.

> The study of science and engineering should produce a sense of the process of argument necessary for advancing and defending a new idea or an explanation of a phenomenon and the norms for conducting such arguments. In that spirit, students should argue for the explanations they construct, defend their interpretations of the associated data, and advocate for the designs they propose. (NRC Framework, 2012, p. 73)
>
> Argumentation is a process for reaching agreements about explanations and design solutions. In

science, reasoning and argument based on evidence are essential in identifying the best explanation for a natural phenomenon. In engineering, reasoning and argument are needed to identify the best solution to a design problem. Student engagement in scientific argumentation is critical if students are to understand the culture in which scientists live, and how to apply science and engineering for the benefit of society. As such, argument is a process based on evidence and reasoning that leads to explanations acceptable by the scientific community and design solutions acceptable by the engineering community.

Argument in science goes beyond reaching agreements in explanations and design solutions. Whether investigating a phenomenon, testing a design, or constructing a model to provide a mechanism for an explanation, students are expected to use argumentation to listen to, compare, and evaluate competing ideas and methods based on their merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to evaluate claims.

2013 NGSS

Grades K-2	Grades 3-5	Grades 6-8	Grades 9-12
Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). - Identify arguments that are supported by evidence. - Distinguish between explanations that account for all gathered evidence and those that do not. - Analyze why some evidence is relevant to a scientific question and some is not. - Distinguish between opinions and evidence in one's own explanations. - Listen actively to arguments to indicate agreement or disagreement based on evidence, and/or to retell the main points of the argument. - Construct an argument with	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). - Compare and refine arguments based on an evaluation of the evidence presented. - Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. - Respectfully provide and receive criticism from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. - Construct and/or support an argument with evidence, data, and/or a model. - Use data to evaluate claims about cause and effect. Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). - Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts. - Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. - Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. - Make an oral or	Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. - Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues. - Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments. - Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining additional information required to resolve contradictions. - Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence.

evidence to support a claim. • Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence.		written argument that supports or refutes the advertised performance of a device, process, or system based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints. • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.	• Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence. • Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).

2013 NGSS

Procedure:

Before Class: Draw the table below on the board.

Claim Statement:				
	Photo 1:	**Photo 2**	**Photo 3**	**Photo 4**
Evidence				
Reasoning				

1. Set the stage for learning by telling students that they will model the scientific practices of "Constructing explanations and engaging in argument from evidence."

2. Distribute the Fisherman Observation Sheet to the class. Students may work in groups of two or individually.

3. Students should scan over the four photos and make an inference about the event. Students identify key actions in the pictures, likely the cause and effect, etc.. Students should develop a story about what has happened to the woman in the photos linking the variables.

4. Distribute Post-It notes and markers.

5. Students will identify possible independent and dependent variables in the scenario by inferring that they are related. Each variable should go onto a separate Post-It Note.

   Possible variables could include:
   a. independent variable (manipulated) - bucket falling, rainy weather, fisherperson trips over rusty nail on deck
   b. dependent variable (responding) - fisherperson falling, fisherperson taking a nap, etc.

6. Review the word "*Claim***"** on the board. These are students' *claims* about what happened in the scenario; how the independent and dependent variables are related. A claim is your argument; it is a belief (one sentence) statement that can be argued against other ideas. It should describe the relationship between the independent and dependent variables.

7. Review the variables to craft a variety of storylines that connects an independent and dependent variable. Write these under Claims. A claim could include, "Fisherperson accidentally knocks bucket off of pier and falls into the marsh trying to get it."

8. Ask students how will we know what the right answer is? Students will likely say "look at the pictures again for more details". Tell students that the word we are looking for is "*evidence*". Evidence is your proof which you take from various sources like research, your field work, articles, interviews, etc. It proves the validity of your reasoning for your claim. This helps to defend your making it even more hard to debate.

   Evidence must be:
   ● Appropriate: Related to your independent and dependent variables
   ● Sufficient: The more data you have, the stronger your claim
   ● Observation-based: Documented by qualitative or quantitative means.

9. Ask students to observe Photo 1 and describe their observations (only what they observe...not infer). Possible observations could include the main character/s, setting, weather, etc. Students write down one key observation in Evidence on the Fisherman Observation Sheet.

10. Repeat with other photos.

11. Review pieces of evidence from each box. With each piece of evidence, ask students whether the evidence support this claim, logically? If so, why? If not, why not?

12. Review "Reasoning". Reasoning is your logical support of your belief or claim; often reasoning answers the question, "Why?". Reasoning makes the claim stronger – more difficult to debate. This connects your claim and evidence to show how your data is is important and linked to science ideas. These sentences usually include "if...then" statements, or uses words like "therefore," "because," and "since". Each piece of evidence must have its own reasoning statement to justify how it supports the claim.

13. Have students explain how the evidence they selected supports their claim.

14. Next, show the Continuous.MOV file to show how this fisherperson fell. Identify the students whose claim and reasoning came closest to the real explanation? Explain.

15. Wrap up this activity by telling students that what they have done earlier is a scientific practice and they will use the same way of thinking about scientific phenomenon.

Student Name: Date: Period:

C-E-R Rubric

Description	3 Points	2 Points	1 Point	0 Points
Claim	Makes an accurate and complete statement linking independent and dependent variables	Makes an accurate but incomplete claim addressing only one variable	Makes an inaccurate claim	Does not make a claim
Evidence	Provided appropriate and sufficient evidence to support claim using qualitative and quantitative observations of both the independent and dependent variables	Provide appropriate but insufficient evidence to support claim	Provides inappropriate evidence. The evidence does not support the claim	Does not provide evidence
Reasoning	Provides reasoning that connects each piece of evidence to the claim. Uses scientific principles to explain why the evidence supports the claim.	Provides appropriate but incomplete reasoning. Each piece of evidence is not supported by a line of reasoning.	Provides inappropriate reasoning.	Does not provide reasoning.
Total				

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Reasoning	Provides reasoning that connects each piece of evidence to the claim. Uses scientific principles to explain why the evidence supports the claim.	Provides appropriate but incomplete reasoning. Each piece of evidence is not supported by a line of reasoning.	Provides inappropriate reasoning.	Does not provide reasoning.
Total				

Student Name: Date: Period:

Fisherman Observation Sheet

I claim that…

	Photo 1. Evidence Reasoning
	Photo 2. Evidence Reasoning
	Photo 3. Evidence Reasoning
	Photo 4. Evidence Reasoning

Images taken from COSEE NOW.

Student Name: Date: Period:

Fisherman Observation Sheet

I claim that…

	Photo 1. Evidence Reasoning
	Photo 2. Evidence Reasoning
	Photo 3. Evidence Reasoning
	Photo 4. Evidence Reasoning

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